A NEW CICADA GENUS AND A REDESCRIPTION OF *PAUROPSALTA SUBOLIVACEA* ASHTON (HEMIPTERA: CICADIDAE) FROM EASTERN AUSTRALIA

[1]LINDSAY W. POPPLE and [2]DAVID L. EMERY

[1]*Ecology, Evolution & Genetics, Building 116, Research School of Biology, The Australian National University, Canberra ACT 0200, lindsay.popple@uqconnect.edu.au*

[2]*McMaster Building B14, Veterinary Science, University of Sydney, NSW 2006, david.emery@sydney.edu.au*

Abstract

We erect a new genus (*Samaecicada* gen. nov.) for *Pauropsalta subolivacea* and provide the first description of the female. The acutely extended, straight to slightly inward facing upper lobes of the pygofer, in combination with undeveloped basal pygofer lobes and lack of pseudoparameres, distinguishes this new monotypic genus from all others in the tribe Cicadettini. Observations indicate that its seasonal emergence is erratic and adults are short-lived. Recent specimens have been captured on medium sized shrubs, notably *Hakea* sp., in open woodland containing *Angophora costata* trees on sandstone ridges.

Introduction

Pauropsalta subolivacea Ashton, 1912 was originally described from a single male specimen from “New South Wales”. Recently, additional specimens have been obtained from Northbridge, Maroubra, the Royal National Park and Red Hill, all in the Sydney metropolitan area. The type specimen of *Pauropsalta subolivacea* Ashton, 1912 is housed in the Australian Museum. Despite being in poor condition (with the pronotum and head missing), the most critical morphological features, including the fore and hind wings, opercula and genitalia, are still intact. This specimen, as well as the original description of the species, matches several specimens collected over the past 5 years from sandstone ridges in the Sydney area.

P. subolivacea has acutely extended upper pygofer lobes, which is a typical feature of the genus *Pauropsalta* Goding and Froggatt (Ewart 1989), and easily explains Ashton’s (1912) generic designation. However, the type does not possess an infuscation on the margin at the distal end of hind wing cell 2A, which is a characteristic feature of *Pauropsalta* (Ewart 1989). Therefore, the possibility of its inclusion in other genera within the Cicadettini needs consideration. Some features of the male genitalia suggest affinities with *Fijipsalta* Duffels from Fiji and *Nigripsalta* Boer from New Guinea. However, the combination of unique genitalic characters in *P. subolivacea* preclude it from any of the above genera and, on this basis, we erect a new genus for this species.

Terminology follows Moulds (2005), with additional terms for tymbal anatomy sourced from Dugdale (1972) and Bennet-Clark (1997). Several characters highlighted in the cladistic analysis of Moulds (2005) are included in the generic description. The species redescription follows, with the original description of *P. subolivacea* by Ashton (1912) included here for comparison. Material sourced for this taxonomic work is located in the following collections: AM – Australian Museum, Sydney (holotype male); ANIC – Australian National Insect Collection, CSIRO, Canberra; DE – private collection of D. L. Emery, Sydney; MSM – private collection of M. S. Moulds, Kuranda.

Systematics

Family CICADIDAE Latreille

Subfamily CICADETTINAE Buckton

Tribe Cicadettini Buckton

Samaecicada gen. nov.

Type species. *Pauropsalta subolivacea* Ashton, 1912

Included species. *S. subolivacea* (Ashton, 1912), comb. nov.

Etymology. Named after Samantha Emery, who collected the first recent material of the type species, which led to its rediscovery.

Diagnosis. A small cicada (type species = 12.1-14.0mm total body length). Width of head (including eyes) equal to, or only slightly greater than, width of pronotum across lateral margins, equal to abdomen width (across auditory capsules); width of pronotum measured from lateral angles similar to width of mesonotum measured between fore wings; pronotal collar with lateral angles confluent with adjoining pronotal sclerites; distance between lateral ocelli slightly greater than distance between each lateral ocellus and adjacent eye. Metanotum partially visible. Abdomen length approximately equal to that of head and thorax combined; rounded in dorsal and lateral profile, with sternites projecting well below level of tergites. Fore wings hyaline; costa well-developed and wider across basal cell and at node, with subcostal vein widening distally along length of basal cell, narrower for remainder to node, with slight curvature exaggerating towards node; fore wing with eight apical cells that have lengths similar to or slightly longer on average than ulnar cells; intersection of veins CuA and M slightly closer to the basal cell than the distal ends of both veins CuA and M; lengths of the four distal vein sections that comprise the inner radial cell margin are of approximately equal length. Hind wings with six apical cells (seven or eight if abnormal). Opercula broadly sickle-shaped, rounded along ventral edge; meracantha broad and marginally overlapping opercula; inner margins of opercula clearly separated. Tymbals with long ribs fused dorsally along basal spur; short ribs present; not extending below wing bases. Pygofer roughly narrowly ovate in dorsal view; upper lobes acutely extended, straight to slightly inward-facing, dominating the pygofer, including dorsal beak; basal lobes not developed; uncus poorly developed, with subtle, posteriorly receding lobe; claspers prominent, curved anteriorly, projected ventrally and curved slightly posteriorly to a subacute termination. Aedeagus simple, without

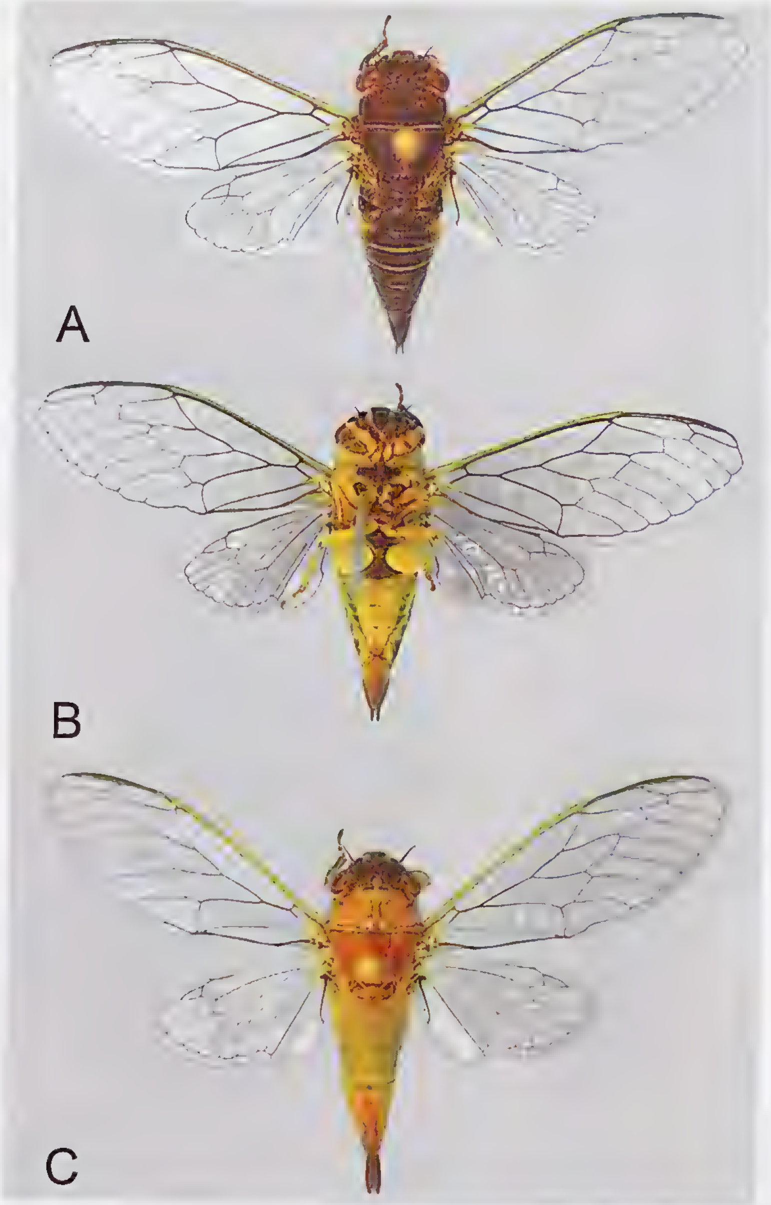

Fig. 1. *Samaecicada subolivacea* comb. nov. from Royal National Park, New South Wales: (A) male, dorsal; (B) male, ventral; (C) female, dorsal. Total body lengths = 12.8mm (male) and 14.0mm (female).

pseudoparameres; theca sclerotized throughout, extending directly from basal plate, without ventral support.

Distinguishing features. The unique characteristics of the male genitalia act as the most useful diagnostic features for this genus. The presence of prominent, acutely extended, straight to slightly inward facing upper lobes of the pygofer, in combination with the absence of basal pygofer lobes, distinguishes this new monotypic genus from all others in the tribe Cicadettini. Other genera that show some affinities with *Samaecicada* are *Nigripsalta*, specifically the type species, *N. carinata* Boer, and *Fijipsalta*. *N. carinata* also has greatly produced upper pygofer lobes and a similarly shaped theca to *Samaecicada*; however, in *Nigripsalta*, the upper pygofer lobes are broad not acute and the claspers are not so prominently developed (Boer 1999). *Fijipsalta* is easily distinguished by having more rudimentary and rounded upper pygofer lobes (Duffels and Ewart 1988). Australian cicadas that could be confused with *Samaecicada* include members of the *Cicadetta forresti* (Distant) group (including *C. capistrata* (Ashton), *C. froggatti* (Distant), *C. juncta* (Walker), *C. sulcata* (Distant) and *C. viridis* (Ashton)), *Graminitigrina* Ewart and *Pauropsalta* Goding and Froggatt. The *C. forresti* group is most easily distinguished by their tymbals with eight long ribs and well-developed basal pygofer lobes. *Graminitigrina* and *Pauropsalta* both have developed basal pygofer lobes and all known *Pauropsalta* species have dorsal pseudoparameres (Ewart and Marques 2008). *Samaecicada* lacks each of these characteristics. As indicated in the introduction, *Samaecicada* also lacks an infuscation on the margin at the distal end of hind wing cell 2A, which is a characteristic feature of *Pauropsalta* (Ewart 1989). The absence of pseudoparameres in *Samaecicada* is significant because these are listed as one of the defining characteristics of Cicadettini as redefined by Moulds (2005). However, this feature is also absent in some species of *Graminitigrina* (Ewart and Marques 2008), so there are other known exceptions.

Samaecicada subolivacea **(Ashton, 1912) comb. nov.**

(Figs 1-4)

Holotype. ♂, NEW SOUTH WALES, 1912, (AM).

Additional material. NEW SOUTH WALES: 1♂, 34^{0}06'S 151^{0}03'E, Wises Track, Royal National Park, Sydney, *Hakea* sp 11.i.2005, S. & D. Emery; 1♂, same location, 3.i.2008, S. N. & D. Emery; 1♀, same location, *Hakea* sp 11.i.2005, S. & D. Emery (all DE); 1♂, 33^{0}44'S 151^{0}15'E, Red Hill Swamp, Sydney, 27.xii.2008, R. Perry (spider's web) (MSM); 1♂, N[or]thb[ri]dge, 30.xi.1927 (ANIC); 1♂, Maroubra, 10.x.1935, G.P.Whitley (AM).

Ashton (1912) described the type specimen as follows:

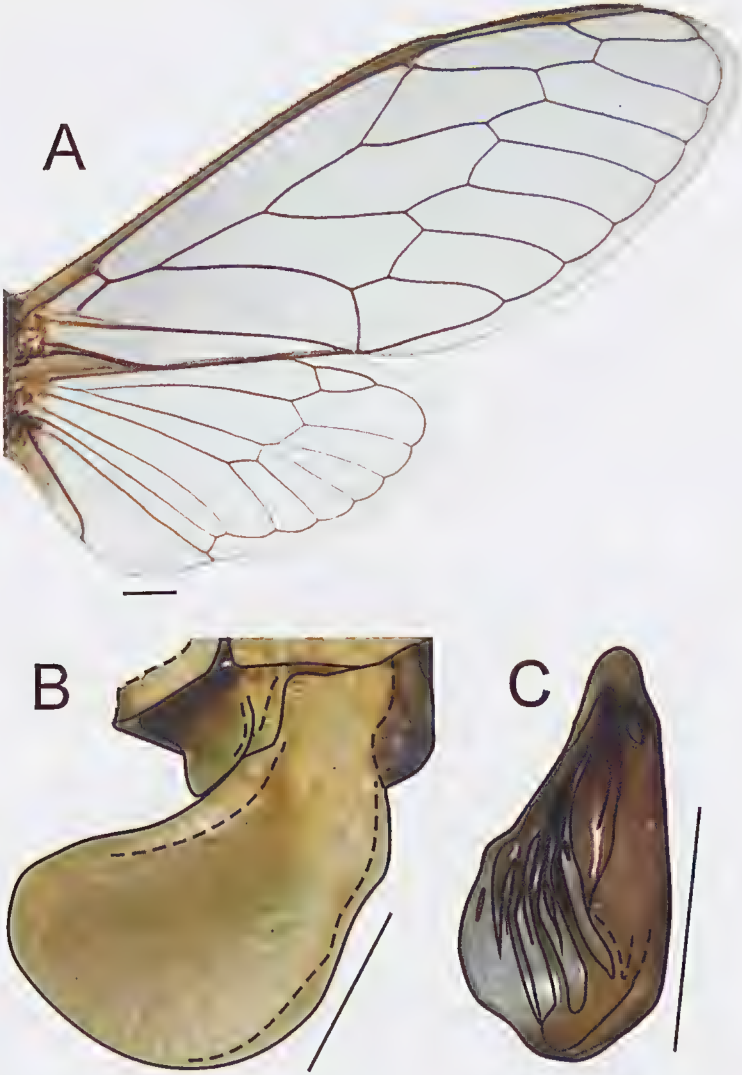

Fig. 2. *Samaecicada subolivacea* comb. nov. (A) right fore and hind wings; (B) left operculum; (C) left tymbal. Photographs taken of specimens from Northbridge, New South Wales (A) and Royal National Park, New South Wales (B and C). Line drawings have been superimposed onto the photographs of the operculum and tymbal (B and C) to assist visualisation of the contained structures. Scale bars 1mm.

"Pauropsalta subolivacea, *sp. nov. male. Head black, pilose, eyes fuscous. Pronotum testaceous, a central black fascia dilated anteriorly and posteriorly (enclosing a pale central stripe). Some spots about the incisures black, posterior margin very narrow, ochraceous. Mesonotum testaceous, two central obconical spots on anterior margin cruciform elevation sordid pale fuscous. Abdomen testaceous, pilose, segments with basal margins black, apex of first and second segment narrowly ochraceous, lateral margins suffused with greenish olive. Body beneath yellow, suffused on legs, opercula and lateral margins of abdomen with greenish olive.*

Tegmina and wings hyaline, costa dull ochraceous margined with black, interior venation black, apical paler. Head, excluding eyes, as broad as long, front [frons] much produced, vertical margins continuous. Pronotum as wide as head, and as long. Mesonotum as broad as pronotum, and, from base of cruciform elevation, as long as pronotum and head together. Abdomen long, slender, tapering, as long as head and thorax.

Long.-(excl. teg.), 14 mm.; exp. teg., 38 mm."

The revised description, with first documentation of the female, is given below.

Male (Figs 1A-B). Head largely black, dorsal surface dull black with red ocelli; postclypeus dull, barred black medially with green lateral and posterior margins, rounded laterally between tops and sides; anteclypeus shiny black; rostrum ochraceous anteriorly, extending into black posteriorly, with length reaching close to posterior edge of mid coxae. Eyes red (live specimens) with greyish coloration at basal posterior margins. Antennae black, supra-antennal plates black.

Thorax with pronotum dull black; midline fascia with variable thin greenish line not reaching pronotal collar; variable and inconspicuous dark brown coloration at bases of paramedian and lateral fissures; pronotal collar shiny black with posterior margin green. Mesonotum black, cruciform elevation black with variable lighter brown ridges; fore wing basal membranes fuscous grey, parapsidal sutures brown in some specimens; metanotum black. Legs with coxae green, each showing a variable brown-black longitudinal lateral fascia, margins black; femora green; tibiae green, with mid tibiae mottled in some specimens, all becoming paler towards base, with spines grading from green at base to black at tips; tarsi green-brown at base, becoming darker brown towards claws.

Wings (Fig. 2A) with fore wing costal veins green, becoming light green posteriorly from the node; basal membranes translucent grey; veins CuA and base of M black, lighter towards base; CuP prominently green to junction with 1A; all other veins black; basal cell transparent; length of fore wings consistently longer than total body length. Hind wing costal vein green; base of vein 1A and 2A light cream, 3A dark brown to black and thickened at base, all other veins black; plaga pale cream at base, becoming transparent towards apical third; cuc1 approximately 3 times width of cuc2.

Opercula (Fig. 2B) following body axis lateroventrally, broadly sickle-shaped, slightly depressed centrally, rounded and slightly raised at ventral margin; green to pale yellow; clearly separated. Meracanthus small, broad, green to yellow, pointed, minimally overlapping opercula.

Tymbals (Fig. 2C) with four distinct long ribs; long ribs 1-3 brown dorsally, much paler ventrally and becoming identical in colour to surrounding membrane; long rib 4 brown, comparatively shorter; all long ribs fused dorsally along basal spur, with 1-2 and often 3 also joined ventrally; short ribs present to the anterior of long rib 4 (absent in some specimens), between each long rib and posterior to long rib 1; large ridged dome on posterior tymbal plate with ridges; apodeme pit oval-shaped and conspicuous.

Abdomen with tergites shiny black with contrasting green posterior and extreme lateral margins. Sternite I black with greenish coloration laterally under operculum, sternites II-VI yellow green, sternite VII green becoming darker posteriorly; sternite VIII brownish, with black pubescence.

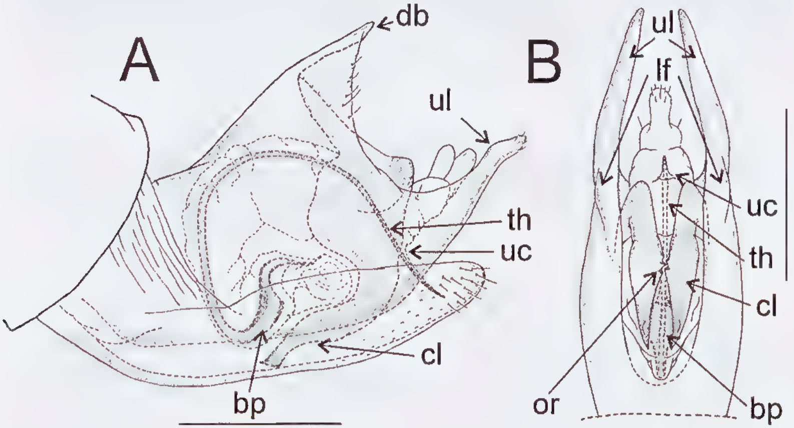

Fig. 3. *Samaecicada subolivacea* comb. nov. Pygofer and male genitalia, viewed (A) laterally from left, and (B) ventrally. Labels refer to following external and internal components: "db" = dorsal beak, "ul" = upper pygofer lobe, "lf" = lateral fold of upper pygofer lobe, "th" = theca, "uc" = uncus, "cl" = clasper, "bp" = aedeagus basal plate, and "or" = tooth-like ornamentation on the inner edge of the claspers (described in the text). Specimen from Royal National Park, New South Wales. Scale bars 1mm.

Genitalia (Fig. 3). Pygofer with upper lobes elongate and acute, extending beyond the posterior end of the abdomen; minor lateral folds evident at ventral base of upper lobes. Uncus subtle, with vestigial posterior projection.

Claspers with undulating curve ventrally, subacute termination; distinct tooth-like ornamentation on inner surface where claspers abut medially. Aedeagus with basal plate acutely downturned at basal end; theca entirely sclerotized, gracile, becoming thinner and gently curved dorsally at apex.

Female (Fig. 1C). Head similar to male apart from a brown spot positioned medially and posterior to ocelli.

Thorax with pronotum mainly green, changing to black anteriorly, with large areas of brown pigmentation either side of midline and a small brown spot on midline immediately anterior to pronotal collar; pronotal collar green with a black spot at each of the lateral margins. Mesonotum brown with inconspicuous cream lines across dorsolateral surface; cruciform elevation arms cream, apex brown, depressions black, grading to cream laterally. Fore wing basal membranes grey. Legs similar to male.

Abdomen with tergites 1-7 green, slightly browner towards midline. Abdominal segment 9 brown dorsally, green laterally, grading to yellow ventrally. Ovipositor brown, noticeably extending 1.5mm beyond termination of abdomen.

Measurements (in mm; range with mean in parentheses: five males, one female). Body length: male 12.1-14.0 (12.8); female 14.0. Fore wing length: male 13.1-14.8 (14.5); female 16.0. Head width: male 3.2-3.7 (3.5); female 4.2. Pronotum width: male 3.4-3.8 (3.73); female 3.6. Abdomen width: male 3.2-3.6 (3.47); female 3.8.

Diagnosis. S. subolivacea is distinguished from other species in the tribe Cicadettinae by the combination of acutely elongated, straight to slightly inward-facing upper pygofer lobes and undeveloped basal pygofer lobes. More thorough comparisons are given under the description of *Samaecicada* above.

Distribution, habitat and behaviour

Known only from old locations in Northbridge and Maroubra, and from recent collections in the Royal National Park and Red Hill "Swamp", all in the Sydney metropolitan area. Ashton's specimen (labelled N.S.W.) would also have most likely been collected in the Greater Sydney area. We anticipate that *S. subolivacea* may occur in areas of suitable habitat outside of the Sydney area; however, it could actually be limited to the Hawkesbury Sandstone region. Adults of this species have so far been encountered on *Hakea* sp. shrubs in areas of open woodland containing *Angophora costata*, growing on sandstone ridges adjacent to heathland (Fig. 4). Emergences seem to be irregular and population sizes upon emergence would appear to be small. All specimens have been taken between mid December and mid January, with adults always having been encountered at heights of less than one metre above ground. Apart from the repeated distress calls when a courting pair was captured in 2005, the song of this species has not yet been

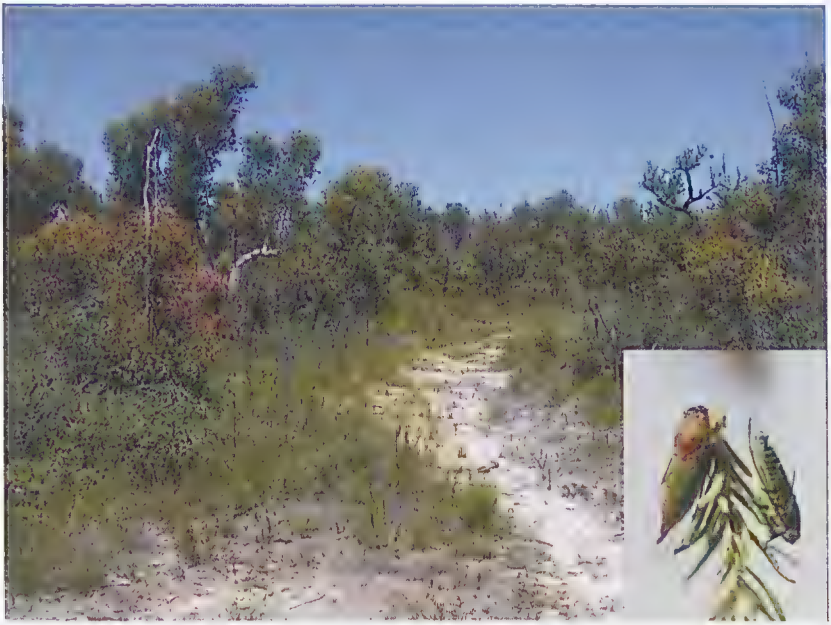

Fig. 4. Habitat of *Samaecicada subolivacea* comb. nov. at Royal National Park, New South Wales. The inset at the bottom right shows live specimens of *S. subolivacea* (female pictured left and male pictured right).

heard or recorded. Perhaps the call is mostly ultrasonic and does not transmit far. No specimens have come to light. Specimens in flight travel less than five metres.

Acknowledgments

We thank Max Moulds, Tony Ewart and Dave Marshall for their most helpful comments on the manuscript, Kathy Hill for encouragement and providing advice on generic comparisons, Samantha Emery for valuable assistance in sourcing new material in the field, Dave Britton for taking the photographs of the set specimens and providing access to the type specimen in the Australian Museum, Cate Lehmann (ANIC, CSIRO) for assistance in obtaining images of important morphological features and Anouk Mututantri for producing the line drawings of genitalia. Tony Ewart also provided comparative illustrations for reference during preparation of the manuscript. Material for this study was collected under permit number S11010, issued to DLE by the New South Wales Department of Environment, Climate Change and Water.

References

ASHTON, H. 1912. Some new Australian Cicadidae. *Proceedings of the Royal Society of Victoria (ns)* **24**: 221-229.

BENNET-CLARK, H.C. 1997. Tymbal mechanics and the control of song frequency in the cicada *Cyclochila australasiae*. *Journal of Experimental Biology* **200**: 1681-1694.

BOER, A.J. de. 1999. Taxonomy and biogeography of the New Guinean Cicadettini (Hemiptera, Tibicinidae). *Deutsche entomologische Zeitschrift* **46**: 115-147.

DUFFELS, J.P. and EWART, A. 1988. *The Cicadas of the Fiji, Samoa and Tonga Islands: Their Taxonomy and Biogeography (Homoptera, Cicadoidea)*. Brill/Scandinavian Science Press, Leiden. 108 pp.

DUGDALE, J. 1972. Genera of New Zealand Cicadidae (Homoptera). *New Zealand Journal of Science* **14**: 856-882.

EWART, A. 1989. Revisionary notes on the genus *Pauropsalta* Goding and Froggatt (Homoptera: Cicadidae) with special reference to Queensland. *Memoirs of the Queensland Museum* **27**: 289-375.

EWART, A. and MARQUES, D. 2008. A new genus of grass cicadas (Hemiptera: Cicadoidea: Cicadidae) from Queensland, with descriptions of their songs. *Memoirs of the Queensland Museum* **52**: 149–202.

MOULDS, M.S. 2005. An appraisal of the higher classification of cicadas (Hemiptera: Cicadoidea) with special reference to the Australian fauna. *Records of the Australian Museum* **57**: 375-446.